

2. Remarks

a. *The § 102 and § 103 Rejections*

The current amendments to the claims distinguish the invention from the prior art.

The Examiner has rejected claims 1 - 4, 6 - 9 and 11 - 14 as anticipated by, or obvious in view of various references. None of those references disclosed the use of phosphorous in the alloy. However, because the amount of phosphorous in claims 2, 3, 7, 8 and 12 read on zero, the Examiner's position is that phosphorous may be eliminated from the claimed alloy. In rejecting claims 5 and 10 under § 103, the Examiner cites Japanese reference JP 2001058286 (abstract) because it does disclose phosphorous at .2%.

As currently amended, phosphorous is a required element in every claim. Thus, in claim 1, phosphorous is present in an amount of not more than 0.01%. In claim 6, the solder is prepared by mixing tin, silver, indium, copper and phosphorous, and the proportion of phosphorous in the solder is not more than 0.01%. Similarly, in claim 11 the solder is formed by combining tin, silver, indium, copper and phosphorous. The language used in these claims mandates that phosphorous is present in the alloy, and as such, the amount of phosphorous in these claims can not read on zero.

None of the prior art references anticipates the amended claims. As conceded by the Examiner, "The difference between the reference(s) and the claims are as follows: the cited references' solder alloys do not disclose P element." (March 24, 2003 Office action, paragraph 5.) As noted, however, the Examiner rejected these claims because the amount of phosphorous read on zero. Because phosphorous is now required and positively recited in every claim, and because there is no single reference that discloses each limitation found in the claims, none of the references anticipates the claims under § 102.

Further, there is no combination of references that would render the claims obvious. The only reference that even arguably could teach the use of phosphorous is the Japanese '286 document. For the reasons set forth below, the claims as

amended are not obvious in view of this document, even if combined with any other reference cited by the Examiner.

The lead-free solder alloy disclosed and claimed in the present application is for use in wave-soldering. As detailed in the specification, wave-soldering presents unique technical concerns and alloy requirements since the alloy is held in a molten state at high temperatures for substantial periods of time. Specifically, oxidation and skinning are significant problems that must be addressed in an alloy that is to be used in a wave-soldering machine. Prior lead-based solders did not have oxidation and skinning problems, but present other problems. The inventors have solved these problems by addition of phosphorous to the alloy in an amount not greater than 0.01%.

In addition to every claim in the application positively requiring phosphorous, every claim is now amended to specify that the solder is used for wave-soldering. The Japanese '286 solder is for use in surface mount technology (SMT) soldering. Oxidation and skinning are not of concern with SMT soldering because the alloy is not held in a molten state for any significant period of time. Moreover, the alloy requirements for an SMT solder are very different from a wave-soldering alloy in other respects. This is reflected by the composition called out in the Japanese '286 reference: tin/silver base containing only 0.2 – 1% silver, with small amounts of antimony and/or copper or nickel, cobalt, iron, manganese, chromium and/or molybdenum as strengthening agents, bismuth indium and/or zinc as melting point-lowering elements, as well as phosphorous, gallium and/or germanium as antioxidants. Such a solder for an SMT process does not suggest to one skilled in the art to use phosphorous in an alloy for a wave-soldering machine that has different composition, as claimed.

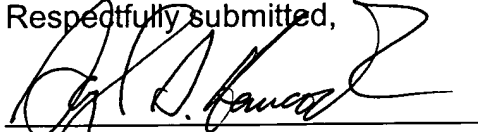
As detailed in the specification, there are many reasons why replacements are being sought for lead-based solders, including significant environmental concerns. However, prior lead-free solders have undesirable properties, including poor wetting, excessive drossing and fillet lifting issues. The inventors have found that the lead-free solder now set forth in the claims addresses these and other technical problems associated with prior lead-free alloys. The claimed solder may

be used as a drop-in replacement for lead-based solders in wave-soldering machines.

3. Conclusion

As now amended, the claims pending in the application are believed to be in condition for allowance, and such action is requested. If any issues remain outstanding the Examiner is requested to contact the undersigned by telephone.

Respectfully submitted,



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